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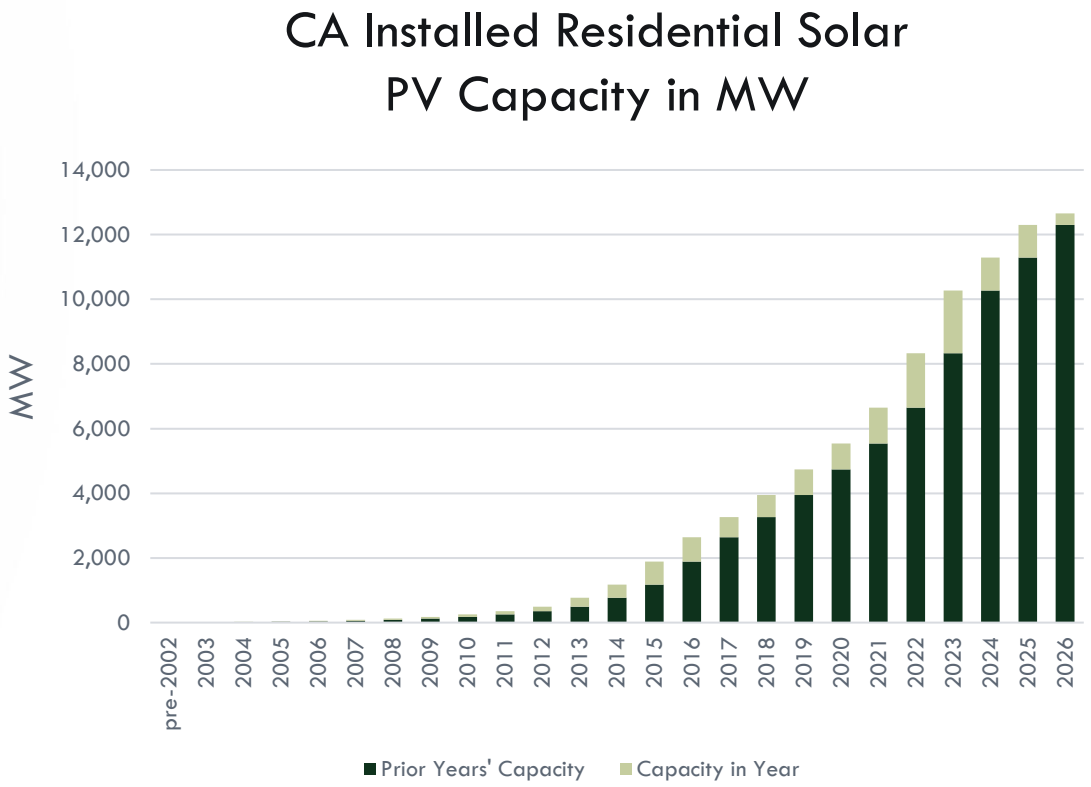
IMPACTS OF PV INSTALLATION ON RESIDENTIAL ENERGY CONSUMPTION

VERDANT

RESIDENTIAL PV HAS GROWN SUBSTANTIALLY IN CALIFORNIA



Source: California Distributed Generation Statistics (DGStats)

CONSUMERS MAY CHANGE THEIR ELECTRICITY USAGE PATTERNS FOLLOWING PV INSTALLATION

The Solar Rebound Effect: Increases in energy consumption following PV Installation

2012: Early PV installation did not create lasting, directional impact on how much electricity residential customers used

2021: SDG&E PV-adopters increased consumption by between 7 and 18% per year

2022-2024: Participants in a no-cost solar program show consumption increases ~10%

In **Europe and Australia,** research in the past decade has identified solar rebounds ranging from **10 to 35%**

Sources: McCallister 2012; Elliot and Shelton 2022; Havas et al. 2015; Deng and Newton 2017; Boccard and Gautier 2021; Aydin, Brounen, and Ergun 2023.

OBJECTIVE

Quantify the extent to which California customers change their electricity consumption post-PV adoption

METHODOLOGY OVERVIEW

Difference in Differences Approach, Matched Control Group

1. **Customer Segmentation**
   Separate customers into groups based on key factors that impact their energy usage

2. **Development of a Matched Control Group**
   Identify set of customers who did not install solar PV whose usage resembled those who did

3. **PV Simulations**
   Utilize per-customer system information and estimate total energy consumption

4. **Difference in Differences Modelling**
   Assess how PV-installers changed their usage beyond changes that occurred in the control group

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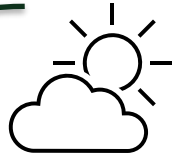
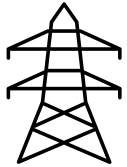
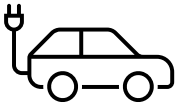


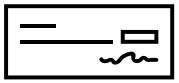
Climate Region
From Title 24 climate zones, mapped using customer zip code



Customer Size
Based on average annual pre-period usage



EV Ownership
Identified with DMV registration data



CARE/FERA Status
Determined using customer rate data

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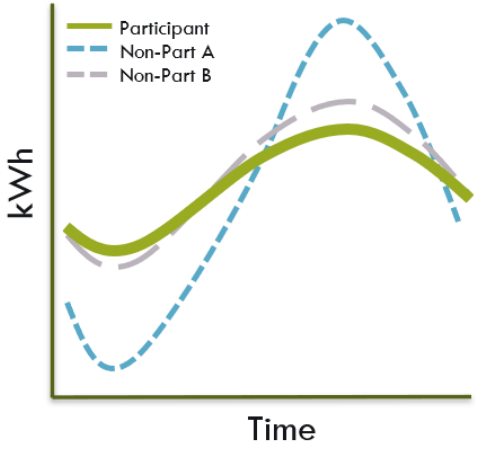
A matched non-participant in the same customer segment is selected for each PV installer



This process substantially benefits from the size of the CEC AMI database

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Customer-specific simulations using actual weather data from the nearest CALMAC station

Simulated PV energy production was added back to net load to arrive at estimate of whole house consumption after adoption of solar PV

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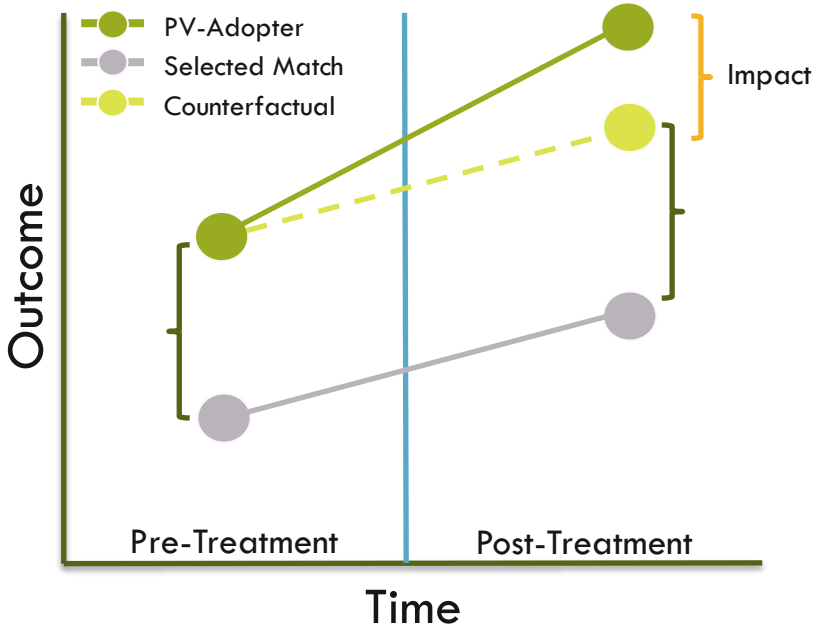
DIFFERENCE IN DIFFERENCES

Assess how differences in the control group compare to those of the PV-adopter group



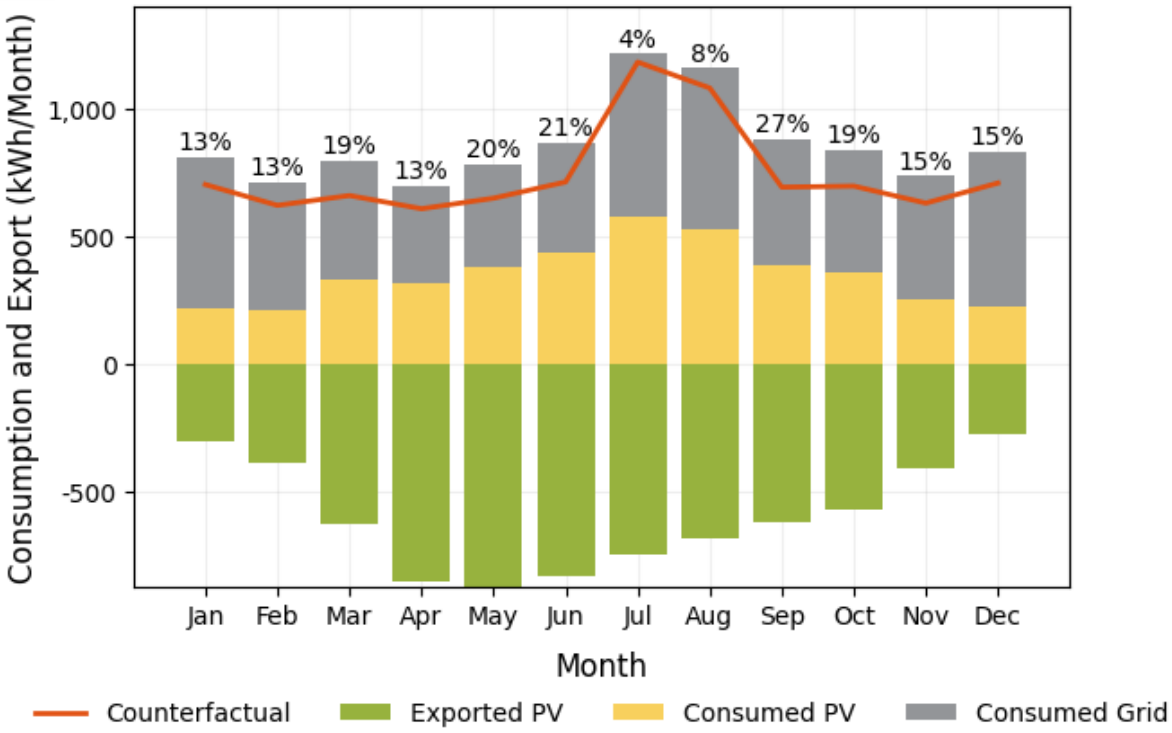
SAMPLE SIZE

» This analysis includes approximately **16,000 SCE and PG&E customers** who adopted PV systems between January and September 2023

Climate Zone	# EV Owners	# Non-EV Owners
Coastal	1,785	2,483
Coastal-Inland	1,585	2,111
Inland	1,310	4,996
Desert	-	1,495
Mountain	-	425

PV ADOPTERS SHOW CONSUMPTION INCREASES IN ALL MONTHS OF THE YEAR

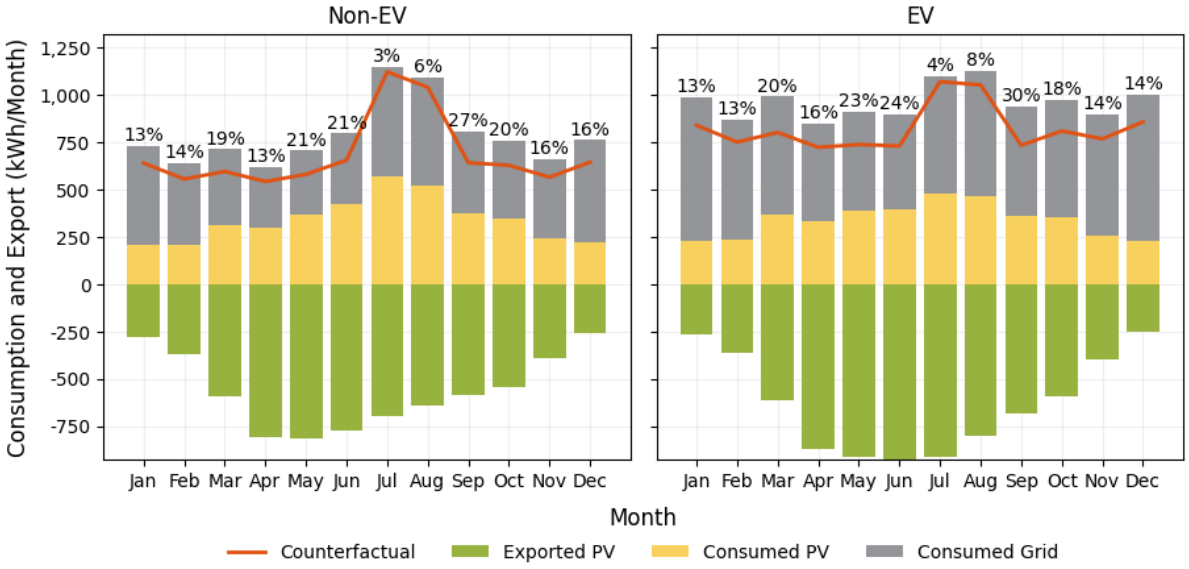
Median monthly increase is 15%



*All results are significant at the 90% confidence level

EV-OWNERS INCREASE CONSUMPTION MORE THAN NON-EV OWNERS

However, differences are small, at a **maximum** of three percentage points



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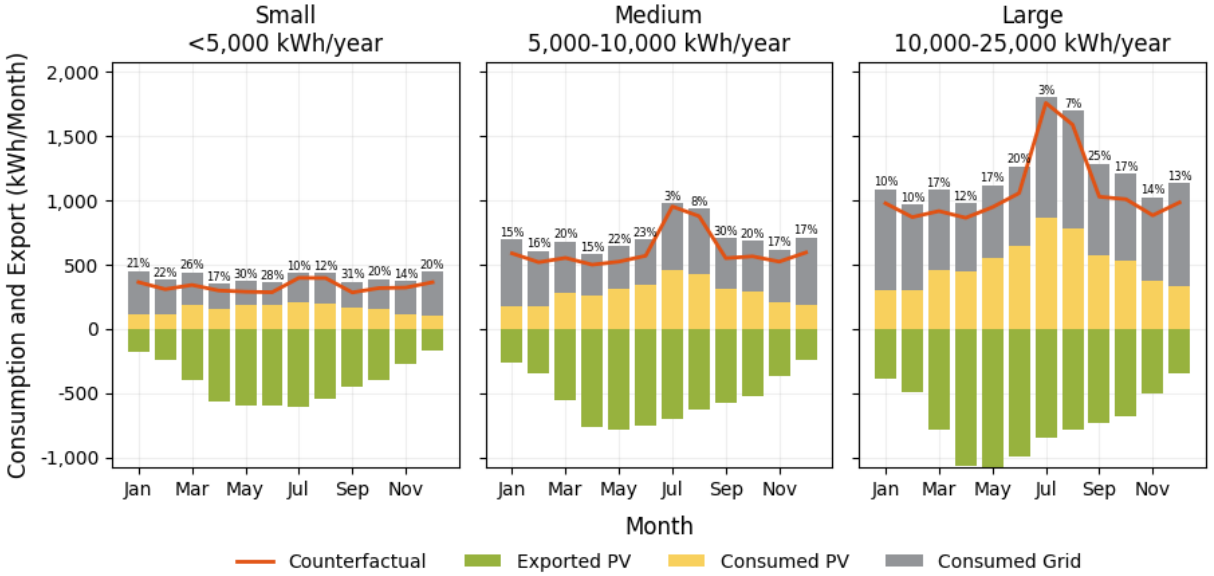
SMALL USAGE CUSTOMERS SHOW THE HIGHEST CONSUMPTION INCREASES AS A PERCENT, BUT THE LOWEST IN ABSOLUTE KWH

Median Consumption Increases

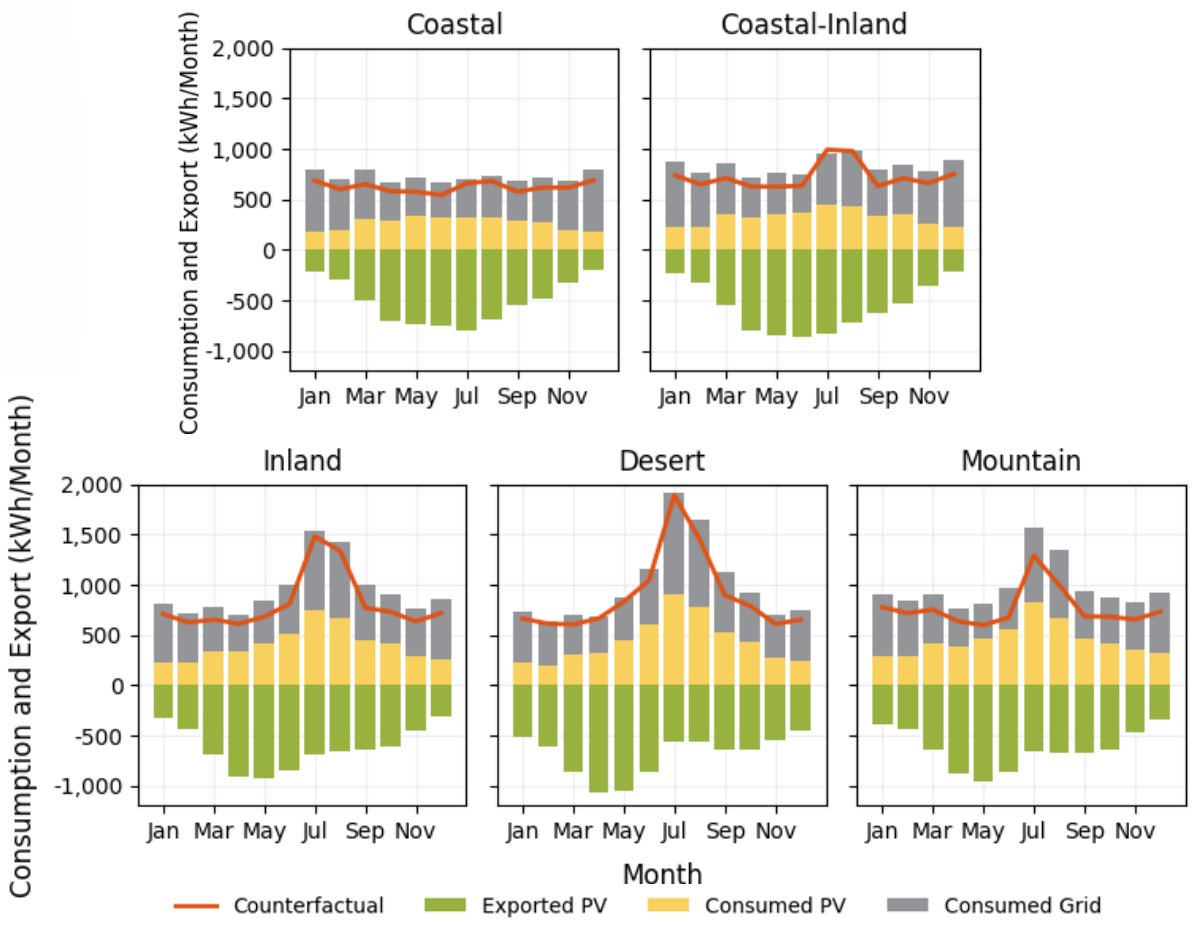
Size	kWh	Percent
Small	70	21%
Medium	97	17%
Large	124	13%



*All results are significant at the 90% confidence level

INLAND AND MOUNTAIN REGIONS SHOW THE HIGHEST CONSUMPTION INCREASES

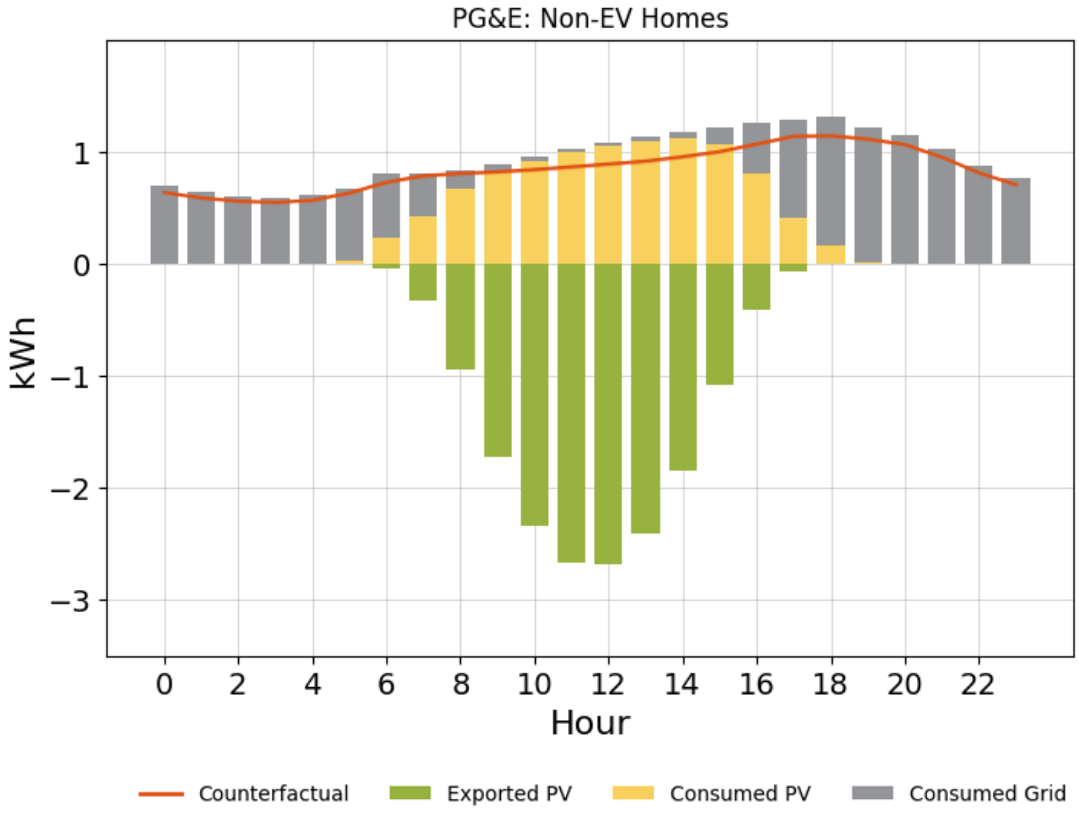
Increases are lowest in the Desert region



*All results are significant at the 90% confidence level
Except for the Desert Region in months April, May, and July

CONSUMPTION INCREASES ARE CONCENTRATED IN MID- TO LATE-PV GENERATION HOURS

However, hourly results are noisier than daily or monthly results



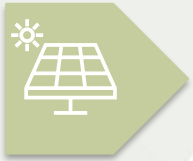
FUTURE CONSIDERATIONS

Incorporate Results into Residential Forecasting

Apply estimated adjustments to post-installation energy consumption in CEC energy forecasting models for households adopting PV prior to the NBT.

Update Analysis with NBT Customers

Determine if the impact of PV on consumption changes for NBT customers with income graduated fixed charges.



Incorporate Actual PV Generation Data

If available, incorporating these data will eliminate the error introduced by simulating solar PV generation.

Investigate Drivers of Consumption Increases

EV detection, Heat Pump detection, and survey work would help further disentangle the different contributions to observed consumption changes.


THANK
YOU
VERDANT

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